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(E76-10423) ACCUMULATION OF BLUE-GREEN  
ALGAE IN THE SURFACE WATER OF THE NORTHERN  
BALTIC, 6 AUGUST 1975, GENERATED FROM THE  
CCT-TAPE MSS 5 (ID 2196-0917200) BY A HERTZ  
INK-JET PLOTTER CONNECTED TO A APDP 11/40

N76-28600  
HC #3.50

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00423

Accumulation of blue-green algae in the surface water  
of the northern Baltic, 6 August 1975, generated from  
the CCT-tape MSS 5 (ID. 2196-0917200) by a Hertz ink-jet  
plotter connected to a APDP 11/40 Computer at FOA 3.

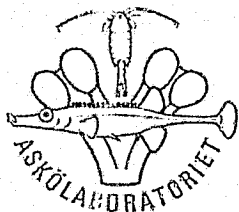
28740

Quarterly Progress Report, LANDSAT-2 Investigation No.28740.

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Stockholm 1976-06-20

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LANDSAT-2 experiment No 28740, The Baltic Sea.

Analysis in the image and the CCT-tape from LANDSAT-2 registrations, how to detect and separate densities in the accumulations of bluegreen algae near the surface for further quantitative estimations have been performed.

All tests have hitherto been made in a registration scene of the north-western Baltic August 6, 1975 ID. 2196-0917200 (Fig. 1).

By using the 70 mm neg. product (MSS 4) and a microdensitometer, a rough estimation of the algal aggregation in the surface water was possible. Measurements to determine heterogeneities in the algal accumulation were less successful because of the aperture of the instrument and the striation in the 70 mm product.

The 70 mm product (MSS 4) has also been tested in an automatic Image Reading Instrument System (IRIS) (ref. Åslund, N., v. Gersdorff, N., Norberg, R., Nordin, J. "IRIS - a two Axis Comparator and Microdensitometer Using two Different Scanning Modes", Proc. of the Conf. on Image Processing Techniques in Astronomy, Utrecht 1975, 229-36.) at the Royal Institute of Technology, Department of Physics, where density differences in the algal accumulations could be recognized (Fig. 2). The measurements have been made with an aperture of 10  $\mu$ m, where each value printed out by the recorder is a mean of 10 measurements in each point along the transect in area I.

This method calls for further tests about the precision and how to handle the striation in the imagery and how to correlate these measurements to our ground truth values.

Promising results have also been obtained by using the CCT-tape of the scene. This technique has been possible to use by accession at the Swedish Institute of National Defence, Dept. 356 (Åkersten, I. A subroutine library for handling Multispectral Pictorial Data. Stockholm. FOA report D 30013-E5(E1), 1974.

By using MSS 4 in a first attempt to separate "water" from algae the graphs in Fig. 3 show that graylevels above 12 indicate algae, where the graylevels 16 and 17 are counts in the most compact parts of the algal accumulation.

Figure 4 shows a line printer picture of section A in area I where following code is used to separate densities in the algal accumulation.

Gray level	Code letter	Algal density
10	B	?
11 & 12	blank	water
13	G	x
14	M	xx
15	T	xxx
16	X	xxxx
17	Y	xxxxx

TABLE 1. Line printer code form Fig. 3a used in Fig. 4.

In MSS 5, 6 and 7, only 5 and 6 will be useful, when MSS 7 as expected gives no information about the algae (Fig. 5b). The 53 pixels in graylevel 2 are scattered over the area and show no correlation to the algae aggregation.



MSS 6 (Fig. 5a) however, indicated differences in the reflected signals but is affected by detector dissimilarities because of striation (Fig. 6) which will be corrected by a smoothing technique.

The graylevel histogram for MSS 5, Fig. 7, indicate again a split up of the reflected information from the surface water containing algae (Fig. 8).

By using the graylevel information obtained in area I another area (area II), was tested. This area is less loaded by algae which is shown in Fig. 9, where more than 95 % of the pixel counts are below graylevel 11. The same trend was found for MSS 5 (Fig. 10).

A small algal streak is shown in Fig. 11 (see Fig. 1B). The "water" north and south of this sweep appear to have different graylevels.

The same situation was found by tests in subareas (61 x 132 pixels) containing no algae, north resp. south of the streak (Fig. 12).

The results indicate the possibility to separate water-masses with different status in relation to ecological parameters in the Baltic.

Our experience during this period point on that estimations and interpretations in the registrations have to be carried out by computer techniques in the CCT-tape or by an automatic image reading system. That means that out effort will be concentrated to improve this techniques in cooperation with the Institute of National Defence and the Royal Technical Institute to find out a way for proper classification in the registrations and for later correlation with our ground truth measurements.

B-O Jansson

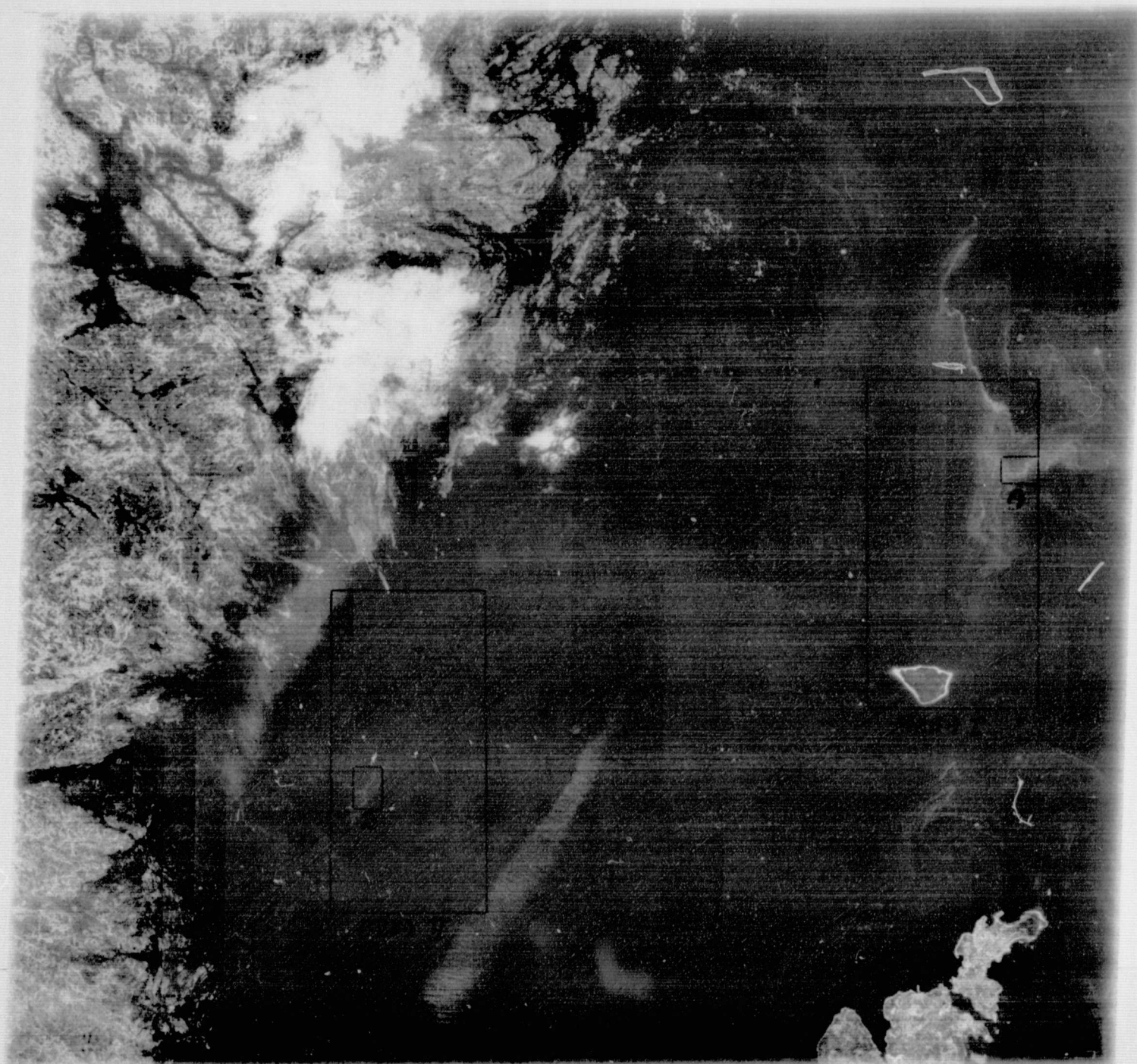
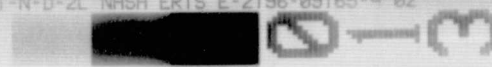
Bengt-Owe Jansson  
Principal investigator

Bo G. Nyqvist

Bo G. Nyqvist  
Co-investigator

06AUG75 C N60-06/E019-24 N N60-06/E019-32 MSS 4

R SUN EL43 AZ149 197-2728-N-1-N-D-2L NASA ERTS E-2196-09185-4 02



06AUG75 C N58-43/E018-25 N N58-43/E018-33 MSS 4

R SUN EL44 AZ147 197-2728-N-1-N-D-2L NASA ERTS E-2196-09172-4 02

Fig. 1. 6 August 1975.

LANDSAT-2 registration (MSS 4) of the north western Baltic, showing the test areas used for interpretation by computer techniques. The streaks in area I and II are accumulations of blue-green algae in the surface water.

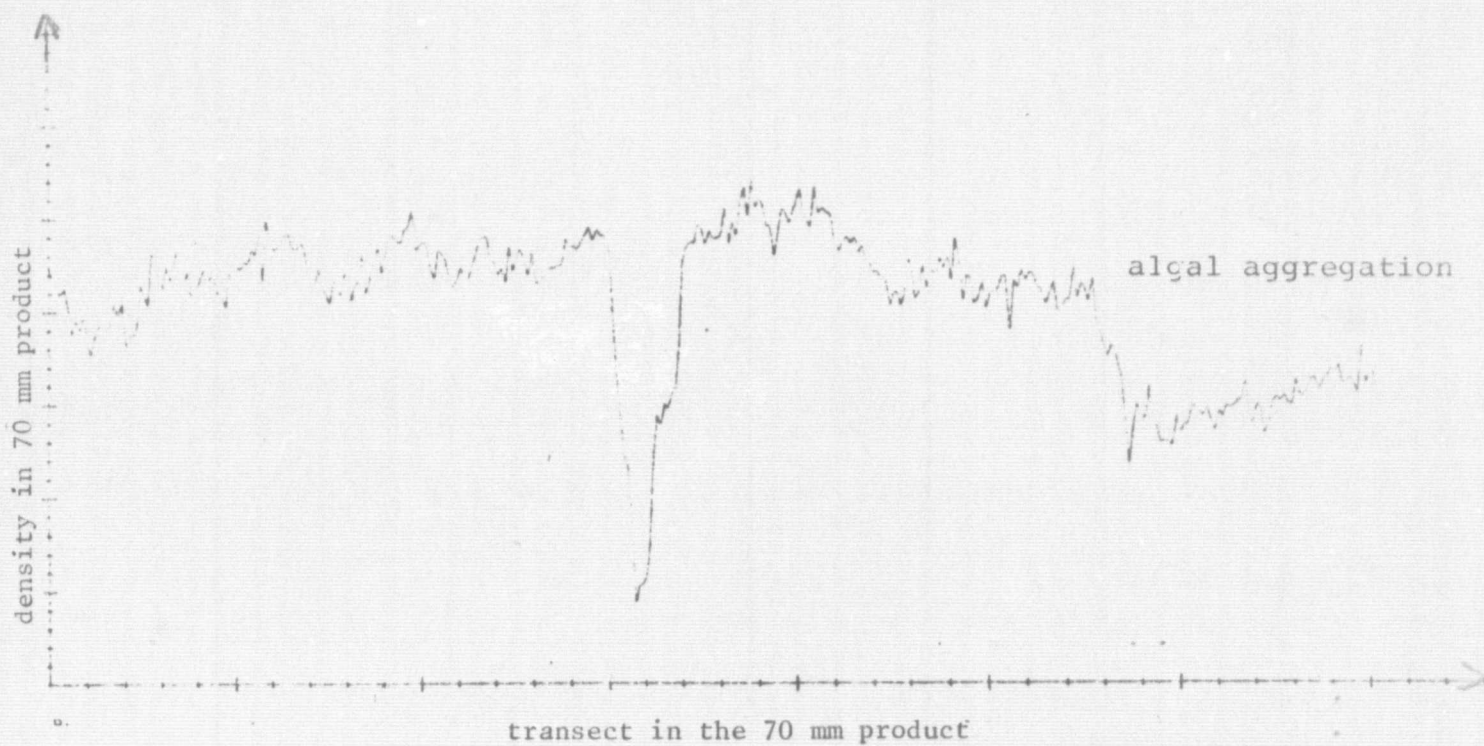


Fig. 2. Density curve along a transect with algal accumulations in area I.

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## SCENE/FRAME IDENTIFICATION LOG FOR FOA355 LANDSAT MSS DIGITAL DATA HANDLING AND PROCESSING ARCHIVE

SCENE/FRAME ID	EXPOSURE DATE: UT	SCENE CENTER LAT LONG	CCTS MERGED	MSS RECTIFIED LINE LENGTH
SDDC-HHMSBN	06AUG75 C	N58-43/E018-25	1 2 3 4	3264
2156-C917200				

INPUT DATASET SUBSCENE:	LINE1	LINES	LOCUS1	LOC1	OF MSSBANDS
N584E182	925	615	2550	400	4 0 0 0
LEVELCOUNTED SUBSCENE:	925	240	2800	132	4 0 0 0

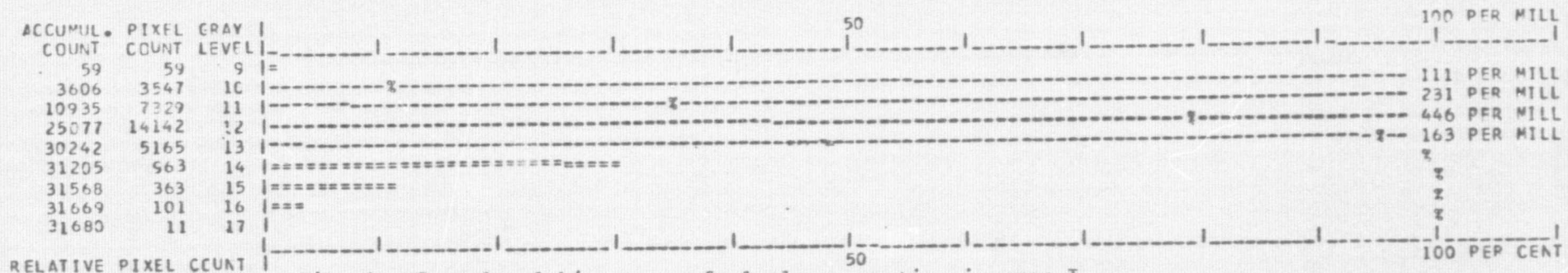


Fig. 3a. Gray level histogram of algal aggregation in area I.

## SCENE/FRAME IDENTIFICATION LOG FOR FOA355 LANDSAT MSS DIGITAL DATA HANDLING AND PROCESSING ARCHIVE

SCENE/FRAME ID	EXPOSURE DATE: UT	SCENE CENTER LAT LONG	CCTS MERGED	MSS RECTIFIED LINE LENGTH
SDDC-HHMSBN	06AUG75 C	N58-43/E018-25	1 2 3 4	3264
2156-0917200				

INPUT DATASET SUBSCENE:	LINE1	LINES	LOCUS1	LOC1	OF MSSBANDS
N584E182	925	615	2550	400	4 0 0 0
LEVELCOUNTED SUBSCENE:	925	120	2550	132	4 0 0 0

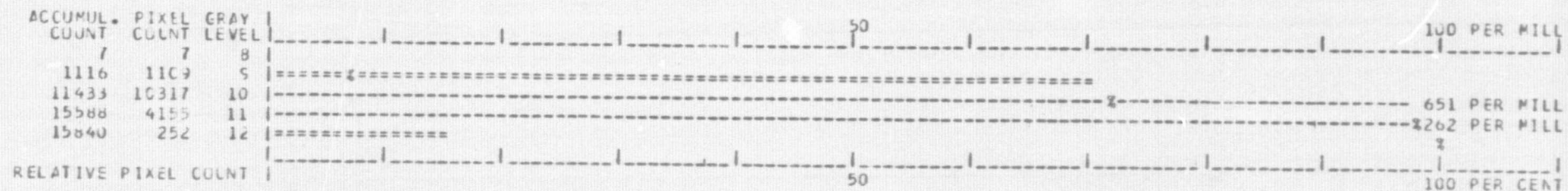


Fig.3b. Gray level histogram of surface water with little or no algae.

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Fig. 4. Line printer presentation (MSS 4) of section A in area I.



INPUT DATASET SUBSCENE: LINE1 LINES LOCUS1 LOCI OF MSSBANDS  
 N584E182 925 240 2800 256 4 5 6 7  
 LEVELCOUNTED SUBSCENE: 925 240 2800 256 0 0 6 0

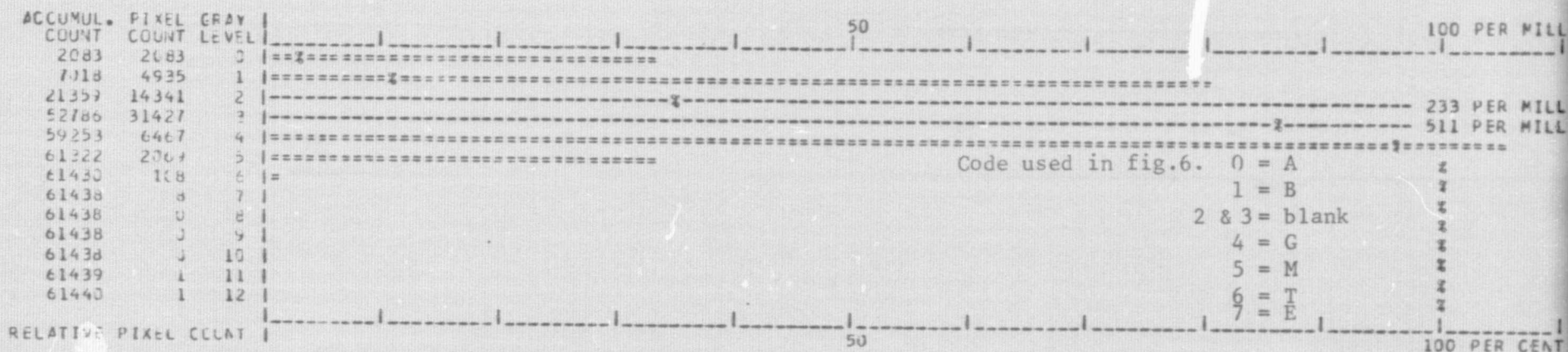


Fig.5a. Gray level histogram (MSS6) of section A in area I.

INPUT DATASET SUBSCENE: LINE1 LINES LOCUS1 LOCI OF MSSBANDS  
 N584E182 925 240 2800 256 4 5 6 7  
 LEVELCOUNTED SUBSCENE: 925 240 2800 256 0 0 0 7

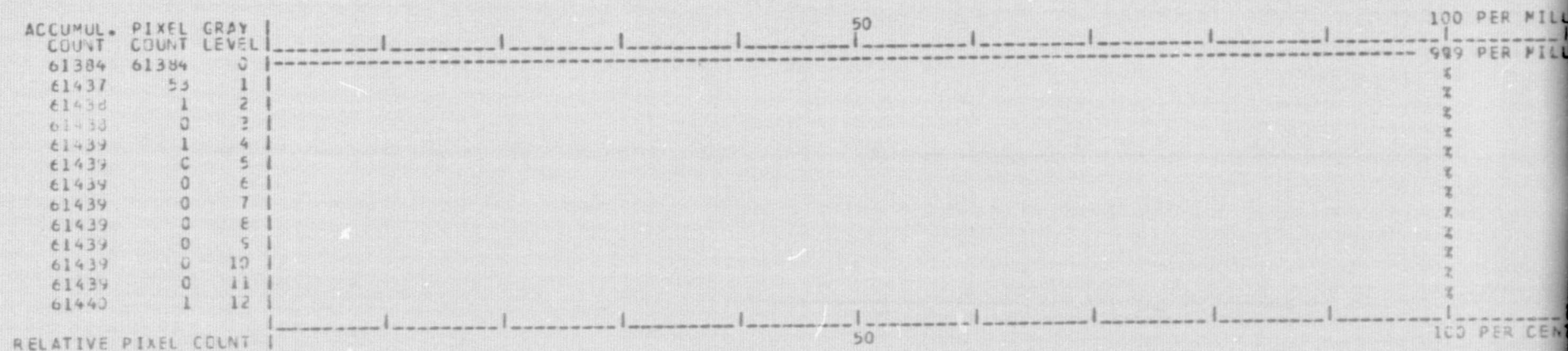


Fig.5b. Gray level histogram (MSS 7) of section A area I.

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INPUT DATASET SUBSCENE: LINE1 LINES LOCUS1 LOCI OF MSSBANDS  
 N004E1E2 925 240 2800 250 4 5 6 7  
 LEVELCOUNTED SUBSCENE: 925 240 2800 250 0 5 C 0

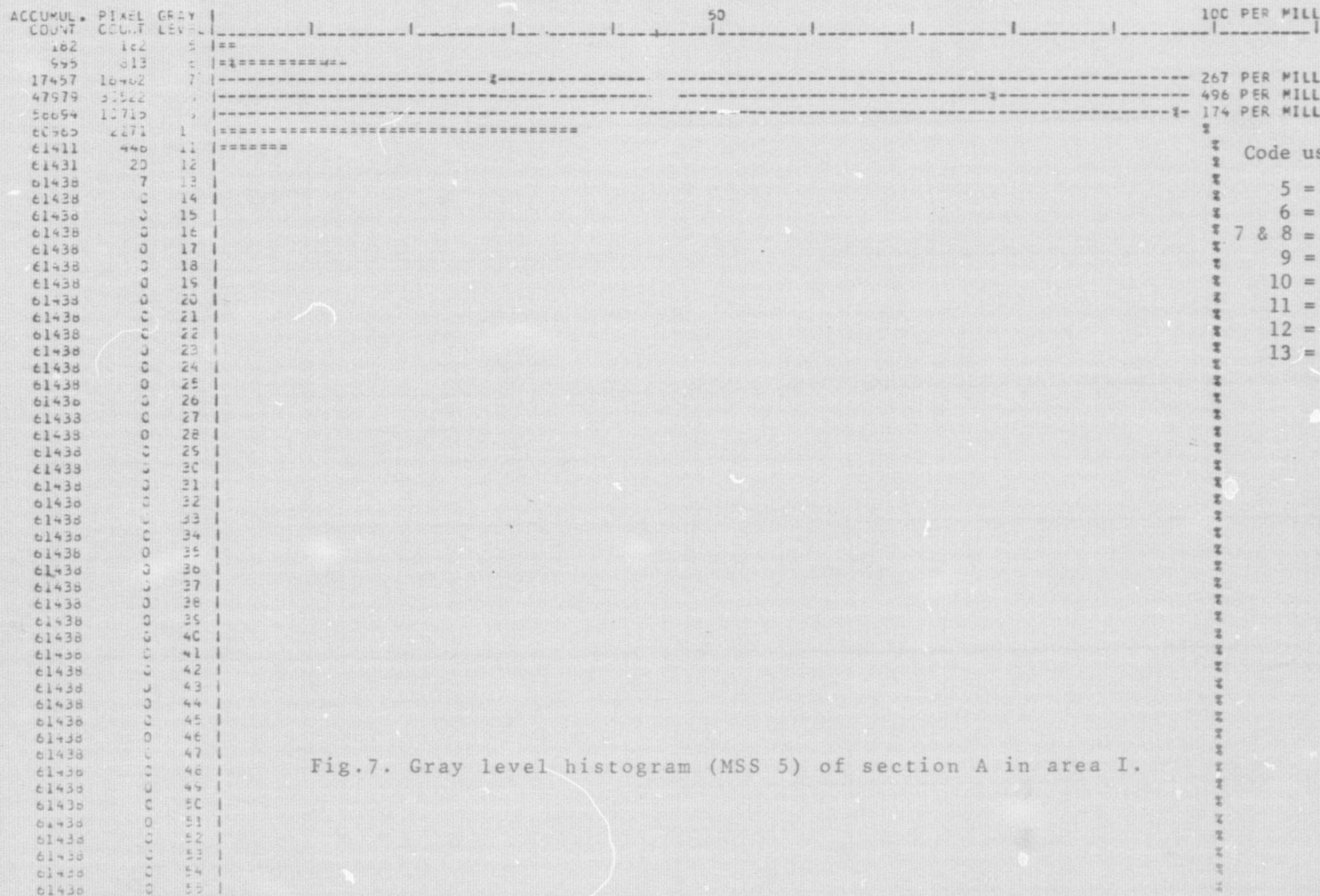


Fig.7. Gray level histogram (MSS 5) of section A in area I.

Code used in fig.8.

- 5 = A
- 6 = B
- 7 & 8 = blank
- 9 = G
- 10 = M
- 11 = T
- 12 = X
- 13 = E

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Fig.8. Line printer presentation (MSS 5) of section A area I.

Fig.8. Line printer presentation (MSS 5) of section A area I.

## SCENE/FRAME IDENTIFICATION LOG FOR FOA355 LANDSAT MSS DIGITAL DATA HANDLING AND PROCESSING ARCHIVE

SCENE/FRAME ID	EXPOSURE	SCENE CENTER	CCTS MERGED	MSS RECTIFIED
SDCO-HMMSEN	DATE; UT	LAT LONG	1 2 3 4	LINE LENGTH
2196-0917200	06AUG75 C	N58-43/E018-25		3264

INPUT DATASET SUBSCENE:	LINE1	LINES	LOCUS1	LOC1	OF MSSRANDE
BALTIC	1555	305	960	600	4 5 0 0
LEVELCOUNTED SUBSCENE:	1555	305	960	600	4 0 0 0

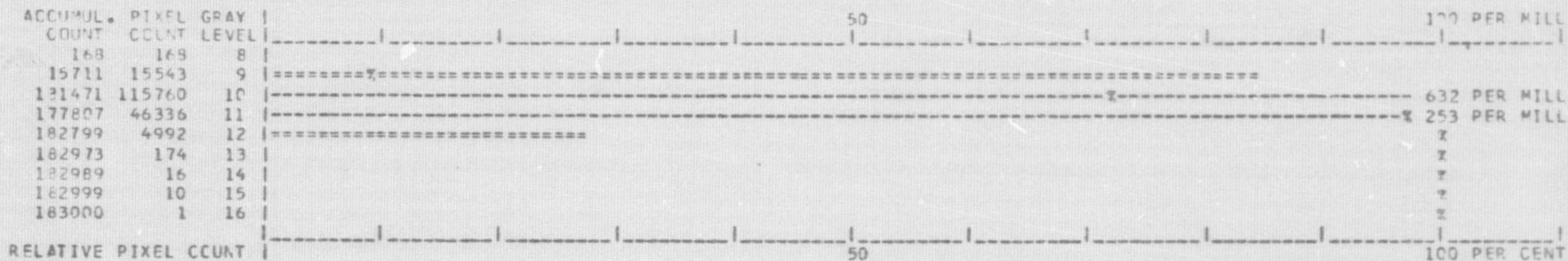


Fig. 9. Gray level histogram from the southern part of area II (MSS 4).



## SCENE/FRAME IDENTIFICATION LOG FOR F0A355 LANDSAT MSS DIGITAL DATA HANDLING AND PROCESSING ARCHIVE

SCENE/FRAME ID	EXPOSURE	SCENE CENTER	CCTS MERGED	MSS RECTIFIED
SDDD-HHMMSS9N	DATE: UT	LAT LONG		LINE LENGTH
2196-0917200	06AUG75 C	N58-43/E018-25	1 2 3 4	3264

INPUT DATASET SUBSCENE:	LINE1	LINES	LOCUS1	LOC1	OF MSSBANDS
BALTIC	1555	305	960	600	4 5 0 0
LEVELCOUNTED SUBSCENE:	1555	305	960	600	0 5 0 0

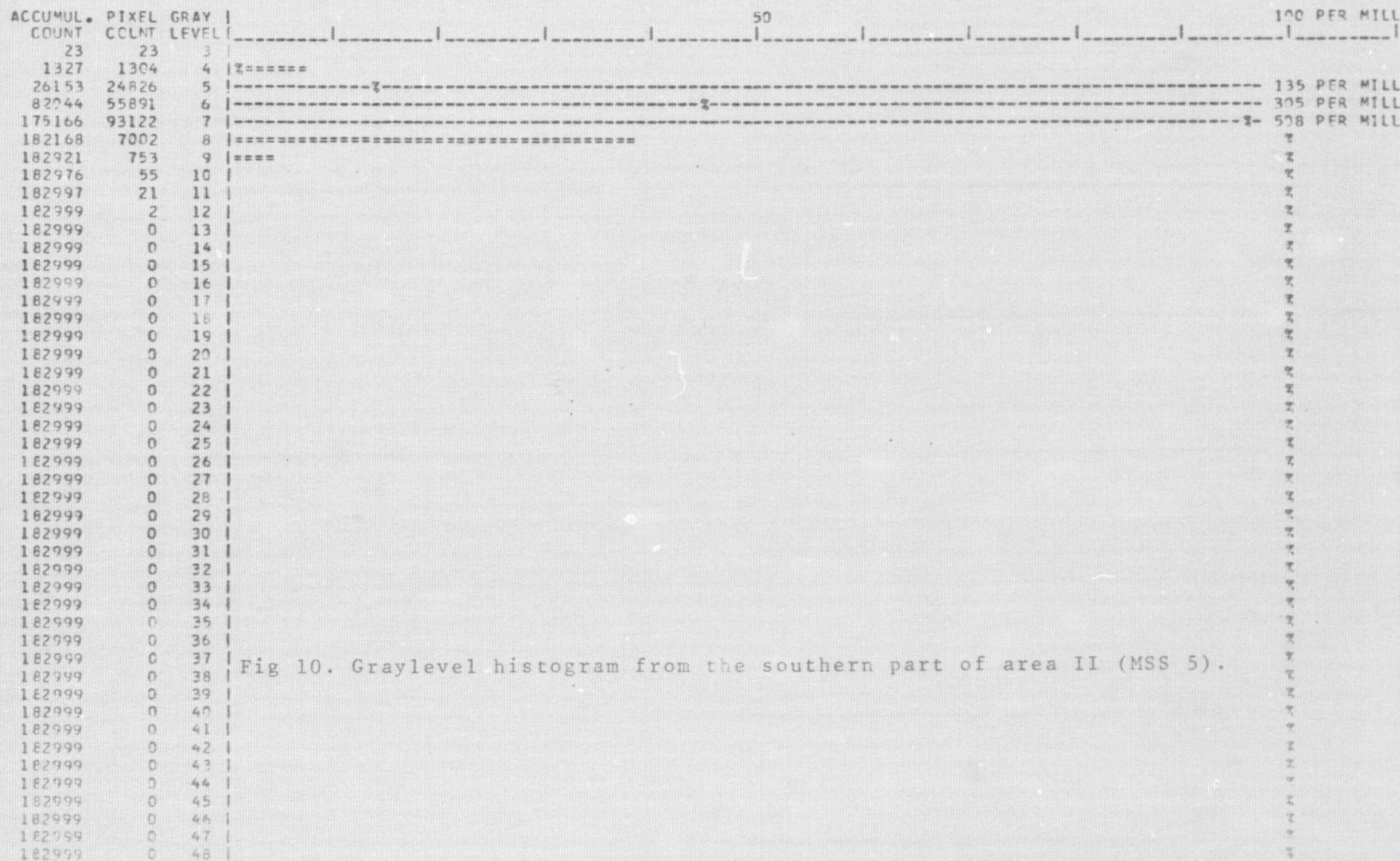


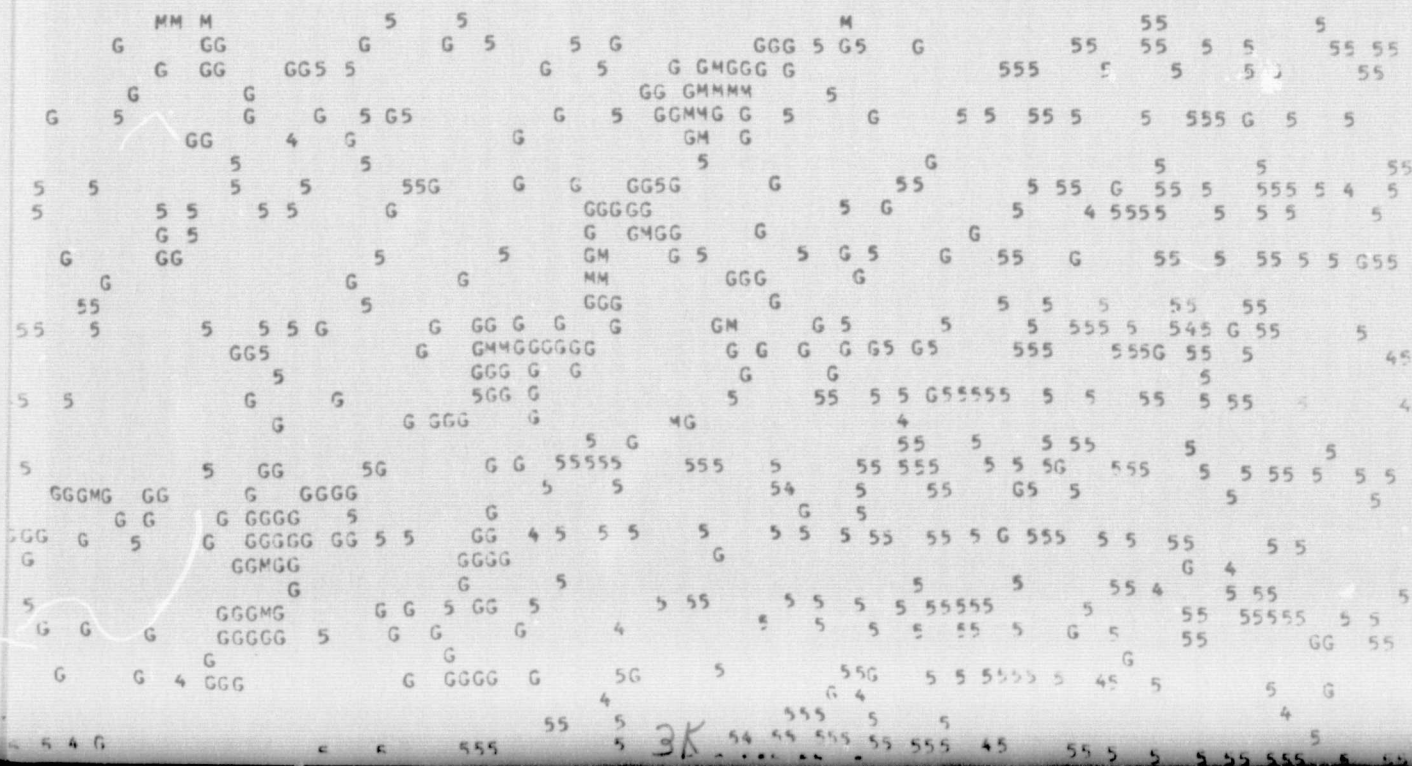
Fig 10. Graylevel histogram from the southern part of area II (MSS 5).

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Fig.11.

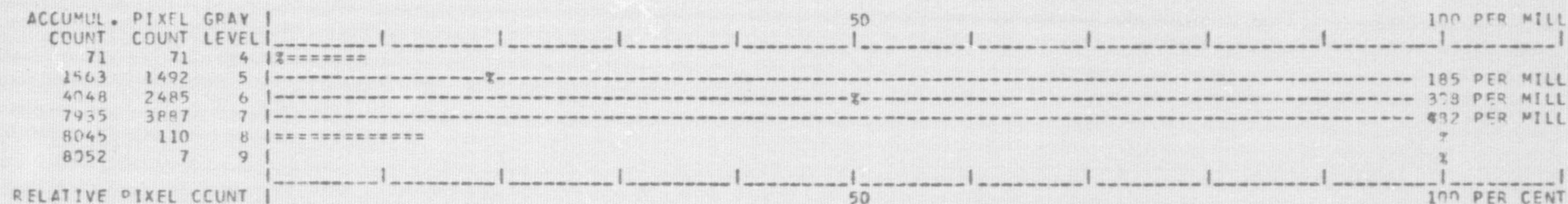
Concentration of blue-green algae in the surface water, registered by LANDSAT-2 750806 in band 5 south of Landsort, northern Baltic.



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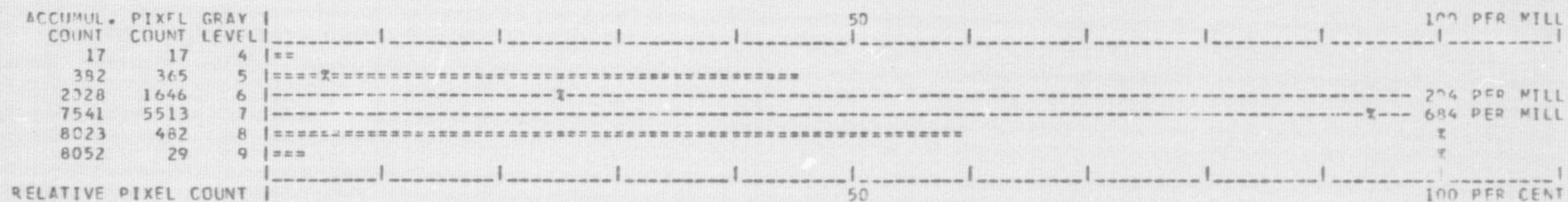


INPUT DATASET SUBSCENE:	LINE1	LINES	LOCUS1	LOC1	OF MSSBANDS
BALTIC	1555	305	960	600	4 5 0 0
LEVELCOUNTED SUBSCENE:	1799	61	1224	132	0 5 0 0



Histogram, "off-shore water".

INPUT DATASET SUBSCENE:	LINE1	LINES	LOCUS1	LOC1	OF MSSBANDS
BALTIC	1555	305	960	600	4 5 0 0
LEVELCOUNTED SUBSCENE:	1555	61	960	132	0 5 0 0



Histogram, "coastal water".

Fig.12. Gray level histogram of different water masses in the Baltic

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